A SHELF MADE OF CERAMIC

Material Exploration of Using Ceramic in Furniture Design

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Master Degree Thesis

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I. Acknowledgements

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II. Abstract

Ceramic is an uncommon material for furniture design and manufacturing due to both practical and economical issues. Therefore, ceramic furniture products withhold a very small place in the world of design. An iconic example of such unique furniture, Ci Zuo Dun, can be found China. However, very little is known about its background. Therefore, this thesis aims to expand the territory of ceramic furniture by exploring the story of Ci Zuo Dun as well as the connection between ceramic material and furniture products. In addition, this thesis creates a modern day example of ceramic furniture.

The theoretical part of this thesis investigates the ancient representative of ceramic furniture in China: Ci Zuo Dun. One of the findings indicates that in the old days, it was people's needs that helped to create the relationship of ceramic and furniture, and the most well-known ceramic furniture in the world was invented. Based on this investigation, this thesis comes to realize that people's need in the olden days has disappeared, and a new relationship needs to be forged. Since ceramic is a commonly used material in architecture and the connection between furniture and architecture is widely acknowledged, this thesis argues that ceramic should be a material choice for furniture design and manufacturing as well.

The design part of the thesis consists of creation of a ceramic shelf prototype. Its purpose is to vividly demonstrate the connection between ceramic and furniture established in the theoretical part of the thesis. Meanwhile, it showcases the possibility of using ceramic to design a functional furni-

ture. Moreover, the multiple material concept in the design can be adapted to improve practical issues discovered in today's ceramic furniture design.

Expanding the territory of ceramic furniture will enhance the ability of furniture to provide new experiences to people regarding colour, texture and tactile feelings. Furthermore, it strengthens the application of ceramic, widens its use and deepens its connection to the daily life. Both product and material will take the benefit of the newly born "Ci Zuo Dun", and a new life will be given to the two of the oldest and most traditional design fields.

1. Introduction

The thesis topic of ceramic furniture comes from my profession as a furniture designer and my newly growing interest in ceramic making. Right after finishing my first ceramic design which was a piece of architecture inspired sculpture, the exciting feeling of encountering new material rising to peak point, I was asked to settle down with my thesis topic. Having my hands being covered with plaster and slip for six months, I decided to design and make ceramic furniture instantly.

In this thesis, ceramic's definition is following the one given by Kingery et al. (1976): "a non-metallic, inorganic solid." (Carter & Norton, 2007, p. 4). A short description often means a broad coverage. Not specifying ceramic's type from the beginning of the thesis opened up a wide window to explore and be inspired from various disciplines. "Furniture", in turn, is understood in this thesis by the following definition offered by Postell (2012, p. 2): "a broad range of moveable objects organized in four main categories: human body support devices; surfaces and objects to support various activities; storage and display pieces; and spatial partitions". According to him, its purpose is to compose a place through arranging and complement interior space, providing necessary elements in order to satisfy people's need to work, rest and play. The Above definition excludes the type of furniture that has no proper function and works as art piece.

The topic can be recognized as a spontaneous decision, but also a well-thought one. From design perspective, ceramic is rarely used in the field of furniture, and that means new design regarding structure and shape is an

uncharted territory and full of potential to explore. Secondly, people have been fascinated by the unique colour and texture of ceramic material for thousands of years, and enhancing the fascination by expanding the use of material seems palpable. From scientific point of view, firstly, ceramic furniture has higher quality comparing to wood, metal and plastic furniture because of its high hardness. Secondly, it is suitable for most weather conditions and environments as it melts at really high temperature and is chemically stable. Thirdly, because of the tight molecular structure, it resists to dirt and very easy to clean. Fourthly, it is a natural cooler in a hot summer day and a storage of heat in the wintertime thanks to material's poor conductivity.

When the topic was decided, I had been asked by this question over and over again:" why to use ceramic in furniture?" Intuitively, the answer linked to the benefits of ceramic furniture, which were listed above. Furthermore, the answer was revealed from the relationships among architecture, ceramic and furniture, and that was the focus of the thesis research, and the base for the design.

It is obvious to justify the use of ceramic in furniture from the point of view of what it will bring to us. In my opinion, however, it is not enough. The benefits are born with the result, which means that only after the ceramic furniture is designed and built, the benefits will show. Because of that, during the process, the design cannot be inspired by the benefits. Therefore, the benefits and the concept are detached. So to say, the direct connection between the material and object does not make a strong enough case to prove the usage of ceramic, and a third field needs to be introduced to build a strong relationship.

Architecture's profound link to ceramic and furniture makes it a perfect intermediate to connect the material and object. Furthermore, it serves as an inspiration and reference to the design, guides it through the process, and strengthens the concept of furniture made of ceramic.

This master's thesis started with the author's interest in both ceramic and furniture. Then it takes the topic out of the personal territory and through the journey of fact-finding and data researching, further examined ceramic furniture's place in real world. This thesis is a combination of academic research and product design. The research part mainly focuses on the theological aspects of connecting ceramic with furniture. Firstly, it provides an overview background of ceramic furniture in the past and present days,

and by examining the history and current situation, the thesis objective has been established. Secondly, the research question of "why using ceramic in furniture design" is answered through the exploration of the connection between architecture and ceramic, furniture respectively. In addition, ideas and inspiration are generated to be the guidance of the product design. Thirdly, the thesis gives a summary of the shelf design, presents its further implementation, and evaluates the limitations and explains author's personal gain through the journey. The design part translates the connection between ceramic and furniture built in theory into a ceramic shelf design which gives audience a clear and vivid understanding of the thesis objective. Furthermore, it presents the initial ideas of the design through sketch and mockups. Moreover, it has included the manufacturing process of ceramic pieces and wood pieces, along with other materials. Finally, the final prototype of the design is presented in photos and drawings.

In general, the thesis consists following chapters:

Introduction: this chapter includes a brief explanation of the topic choice, an introduction of the research question, and overall content and structure;

Background: this chapter includes a brief history and analysis of what's came before of the ceramic furniture, and introduces the perspective of the research, from what angle to tackle the research question; There are following sections: *Ci Zuo Dun - the Chinese Ceramic Stool*, *Ceramic Furniture Nowadays*, *Objective* and *Research Perspective*.

Research: this chapter explains in detail of the research perspective, and it includes the literature review, data gathering and a analysing. There are following sections: *Ceramic in Architecture*, *Furniture in Architecture*, *the Tale of Scale* and *Inspirations*.

Design: this chapter includes the documentation of the design and making process, and the scientific facts of the final design. There are following sections: *Sketches of Concepts*, *Mockup*, *Ceramic*, *Metal & Wood*, *Assembly*, *Photos of the Final Prototype* and *Drawings and Specifications*.

Conclusion: this chapter concludes the thesis design from its advantage to disadvantage, and give out evaluation from author's perspective. There are following sections: *Design Summery*, *Future Implementation* and *Self-evaluation*.

2. Background

Despite the rarity of ceramic furniture, it has a long history. This chapter gives an overview of past ceramic furniture in the Chinese context as well the modern one in wider context. Being informed by this data, the thesis objective and research perspective are coming to formation.

Figure 6. The rattan Zuo Dun and other ancient furnitures in the painting of "the Story Book of People", by Ying Chou, Ming Dynasty (1368-1644).

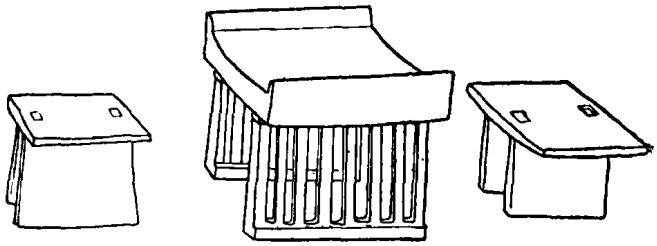


Figure 1. The ceramic table and stools in Sui Dynasty 595 AD.

Ci Zuo Dun - the Chinese Ceramic Stool

The earliest furniture in ancient China with the use of ceramic dated to Sui and Tang dynasties (700 AD), and they were mainly stools and tables (Figure 1). In Qing Dynasty (1600 AD- 1900AD), luxurious complex decoration objects and highly skilled craftsmanship were worshipped. In order to meet with people's need, various kinds of materials had been tested and used in furniture design such as bamboo, metal, seashell, precious stones and ceramic (Zhang, 2011). According to Zhang, ceramic furniture had a great opportunity to grow and develop at that time. Comparing to other periods in Chinese history, the Qing Dynasty had left behind the largest amount of ceramic furniture relic we could see and touch today.

The ancient Chinese ceramic furniture can be categorized into two types: one is mainly made of ceramic, often found in stools (Figure 2). Another one is made of hardwood, and ceramic as decorative material inserted in the main body, often found in tables, beds and cabinets (Zhang, 2011) (Figure 3). This thesis chose the ceramic stool as an example to highlight the development of ceramic furniture in ancient China.

The reason for choosing Ci Zuo Dun, the seating stool made of ceramic, for examination, it is because firstly, it is the intuitive choice. It left a footprint in the name of ceramic furniture in the history of ancient Chinese furniture, and ignoring it means ignoring the history of ceramic furniture. Secondly, Zuo Dun is an ancient type of Chinese furniture made from various materials (Figure 2, 4). Ci Zuo Dun, despite of being made of different material, has remarkable resemblance to the others in shape and in form.

Figure 3. The black painted arhat bed with decorated ceramic landscape painting, early Qing dynasty (around 1700 AD).

Figure 2. The ceramic Zuo Dun of colourful lotus with bolt decoration, Qing dynasty (1725-1796 AD).

Figure 4. The rosewood Zuo Dun with four pillars, early Qing dynasty (16 Century AD).

Therefore, discovering this reason behind the resemblance will be informative and educational. Finally, Ci Zuo Dun is made entirely of ceramic, a pure representation of its kind, and exploring the distinction between it and furniture made of other materials will be enlightening.

Ci Zuo Dun is a material variation of Zuo Dun. Zuo Dun is a type of Chinese ancient seating stool first appeared at the time of Tang Dynasty (600 AD- 900 AD) (Dou, 2012). Evidence from the ancient Chi-

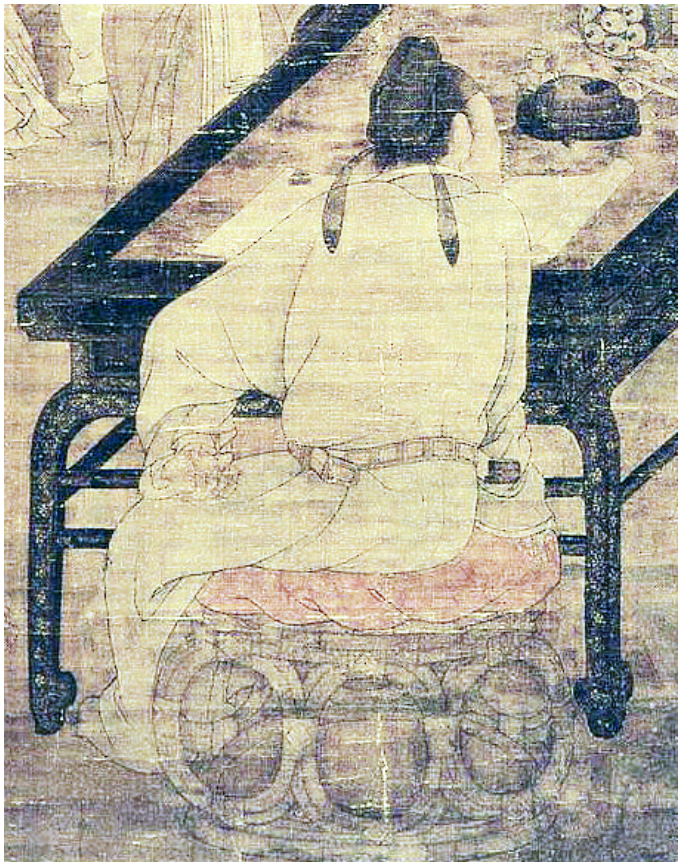


Figure 5. The rattan Zuo Dun in the painting of "Five Scholars from Tang Dynasty (618-907 AD)".

nese ink painting indicates that rattan was firstly used to make Zuo Dun. The rattan was curved and bonded together to form the support structure for the seating surface, which was covered with fabric such as silk (Wang, 2010) (Figure 5). Zuo Dun's shape is similar to the seating tools back in 500 BC – 220 BC, used by women when they burnt incense to warm themselves (Shen, 2002). Its curved outline and elaborate detail expresses lightness and elegance, while the other ancient Chinese furnitures are shaped like cubic with heavy and uptight feeling (Figure 6). Because this hollow shape and delicate style of rattan Zuo Dun was so unique, it became quite popular around the nation and remained unchanged though time, even after the material had been replaced by hardwood, and that became possible thanks to the development of highly advanced wood joinery making. Another reason of its popularity was credited to the mobility and it could

be moved around in various environment settings thanks to the relatively small size and lightweight. In order to adapt to different usage scenarios such as outdoor environment, durable materials were introduced. In Ming and Qing Dynasties (1300 BC- 1910 BC), Zuo Dun made of ceramic and stone started to appear, and the shape and detail were almost the same as before. For example, the drum dots decoration had kept since the very beginning when Zuo Dun's seating surface was made of animal skin and bolted to the support (Wang, 2007). Nevertheless, the reason of changing material from wood to ceramic causing no change of shape was more complicated than the change from rattan to hardwood. On the one hand, the differences between wood and ceramic are much more dramatic than that between rattan and wood regarding material properties and manufacturing techniques. On the other hand, the round and drum shape of Zuo Dun fits perfectly with the throwing techniques in ceramic making. In my opinion, that is the critical reason that ceramic Zuo Dun has the same shape as the Zuo Duns made of other materials. There were differences still: ceramic is the material with strong durability but was hard to cast and fire hollow shape, so the hollow structure of the Zuo Dun had been replaced by closed wall and decorated with small holes and patterns (Figure 2, 4). To this stage, Ci Zuo Dun was born and had the same shape and detail as what we saw today. From the history of Ci Zuo Dun, it is clear to conclude that the development of the daily objects is profound but reluctant. On the one hand, it is pushed by the need. This development, in turn, pushes the technology to meet the need. Then the design is pushed by the development to accommodate the technology. On the other hand, if there's no need, there's no change, not even a single dot decoration.

Figure 7. The obon coffee table by Simone Bonanni.

Figure 8. The Keramos cabinets by Adriano Design and La Castellamonte.

Ceramic Furniture Nowadays

Back in ancient China, Ci Zuo Dun was the one you found in the wealthy and royalty households. Nowadays, you still rarely find furniture made of ceramic in shops and stores that opened on a daily basis, but occasionally you can spot it in art galleries, design exhibitions and public spaces. Large scale ceramic works are always hard to make and produce, which make it too exclusive and expensive to be possessed by the general public. Because of that, today's ceramic furniture are mostly art works, designed and built by ceramicists, and owned by rich individuals and groups.

In general, ceramic furniture at present day can be divided into three groups. The first one is furniture products mainly made of ceramic. There are very few pieces like this in the market. They are the kind that you can find in shops and stores: it includes the Obon coffee table by Smone Bo-

Figure 9. Upholstered Chair by Katharine Morling.

Figure 10. Ceramic furniture by Lee Hun Chung.

Figure 11. Ceramic furniture by Lee Hun Chung.

Figure 12. Public bench at Stockholm Metro Station.

nanni for Moooi (Figure 7); and the Keramos cabinets by Adriano Design (Figure 8). The second group is ceramic art furniture, and this type represents the ceramic furniture nowadays. It has a clear character to distinguish itself from the first group: the craftsmanship. It means that each piece is unique, and that makes the world of ceramic art furniture very diverse and is growing rapidly. In many cases, they can be seen as ceramic sculptures as well since they have the furniture look more than the furniture function. Upholstered Chair by Katharine Morling (Figure 9), and works by Lee Hun Chung are the good examples (Figure 10). The third group is the furniture made of other materials, and uses ceramic partly. Because it is partially used, the drawback of the ceramic material such as heavy weight and brittleness have been reduced, and the material advantage such as colour, texture and chemical resistance show unobstructed. There are indoor and outdoor furniture examples that have applied ceramic and similar material, such as tea trolley 900 by Alvar Aalto (Figure 11) and public bench in the Stockholm metro (Figure 12).

Looking back to what has been done is a very useful tool to navigate design. The history of Ci Zuo Dun indicates that the long-lasting design is often generated from perspectives other than design itself. Summarizing various ceramic furniture works produced in the present-day helps to specify pros and cons of the material, so that its advantage will be made the best use and its disadvantage will be bypassed.

Objective

The answer to the question" why to use ceramic in furniture design" has been partly revealed from the past. There are three aspects showcased in the story of Ci Zuo Dun which intertwined and work together to put ceramic furniture on the map of Chinese ancient furniture. The first one is ceramic's unique symbolism of wealthy and high-status which was highly appreciated at that time of history. The second one is ceramic's durability meets the birth of the outdoor-use furniture. the last one is Zuo Dun's circular-drum-shape fits uniquely with the throwing technique of ceramic making. In conclusion, the need from the material to be treasured and used outdoors, and the need from the furniture to be shaped through ceramic technique those bond Ci (ceramic) and Zuo Dun (furniture) together. Looking into present days, it is clear to say that these "needs" have receded and disappeared: ceramic is still adored, but not as exclusive nor representative as before. Ceramic is no longer the only suitable material, nor the best to be used in outdoor furniture due to the development of technology. Because of the evolution of diverse society, Zuo Dun is no longer the only outdoor furniture type, nor the one that is popular any more.

In ancient China, ceramic was the only material that fitted into people's demand of using furniture at natural environment, and Zuo Dun was the only furniture type that suited the ceramic making technique, the uniqueness of these relationships helped to establish the concept of "furniture made of ceramic". Moreover, as the society and technology are developing, today, the exclusiveness regarding material selection and furniture type disap-

pears and results in a world in which outdoor furniture is made of different durable materials, and various kinds of shape can be made from ceramic. Ci Zuo Dun, a landmark of ceramic furniture has lost its glory, and the concept of ceramic furniture is diluting, and has been exiled to the outskirts of furniture and ceramic art fields.

Learning from the story of how Ci Zuo Dun was developed and became ceramic furniture icon, this thesis ambitiously attempts to recreate a present day "Ci Zuo Dun", which exercises a new and strong relationship that rejoins the material and the object together, and to put ceramic furniture back to the map of modern furniture design.

Research Perspective

It is clear to say that in the case of Ci Zuo Dun, the connection of ceramic and furniture is built from within: the material property and the furniture type. If new relationship needs to be built, it might be built from the fields other than ceramic and furniture. The strategy of finding enlightenment from other design and industry disciplines was born.

Looking into a third area of expertise to join the two worlds means an intermediate needs to be introduced to build the bridge of connection. Architecture, which has profound relations with both ceramic and furniture is instantly comes to mind.

3. Research

In this chapter, the analysis of architecture's relationship with ceramic is from historical, functional and regional perspective. In addition, the research of the relationship with furniture begins with a brief explanation of the human living condition, along with analyses of famous furniture and personal experience. Furthermore, through the investigation of Stonehenge, furniture is connected with architecture from the scale aspect. At last, inspiration from this research has been gathered to guide the design of a ceramic furniture prototype.

Figure 13. Ceramic cones pressed into mud served as protective layer, Uruk, Samaria.

Ceramic in Architecture

Putting brick aside, which was born at the very beginning of human civilization (Campbell & Pryce, 2003), the history of ceramic using in architecture dated back to ancient Egypt when the fired ceramic titles were first introduced (Bechthold, Kane, & King, 2015). According to Bechthold, Kane and King (2015), from ancient histories to nowadays society, civilizations never stop using ceramic in buildings, space and structures, and never stop using it as decorative surfaces (Assyrians and Babylonians), protective layers (Sumerians) (Figure 13), roof tiles (Chinese) and so on.

To produce surface finishes on walls, floors and ceilings, ceramic tile is one of the most obvious choices and the oldest known application of ceramic in building. From the perspective of material, ceramic tile does not only provide the widest range of colour choices, pattern formations and texture effects, but also it offers robust, moister-resistance and hygienic finish. It's the perfect surface material choice for interior design regarding aesthetics and practicality. From the perspective of the tile system, the modularity fits perfectly with the mass production procedure, and allows the application to be on various complex surfaces (Bechthold, Kane, & King, 2015). Moreover, according to them (2015), since ceramic accommodates small scale objects better than the opposite as it has less risk of breaking and cracking during its lifetime, and easier and cheaper to produce and transport, the tile system gives ceramic the opportunity to bear the applications from small (12 X 12 mm) to infinity.

Ceramic is material, but also form, colour and texture. The craftsmanship in ceramic is the clear evidence. No matter through the ways of building, throwing or casting, making two identical pieces of ceramic works are almost impossible. The one-of-kind surface particulars, colour gradient and tactile properties emit intimacy and possessiveness. The immense details of colour and texture processes by ceramic which can only be appreciated at close distance lure people to establish intimate contact. During the contacting, feeling towards the object has gradually enhanced and the connection in between people and objects has been built at mental level. So to say, in the world of architecture, using ceramic in interior not only has the benefit of producing design detail better and faster than using plain white walls, but also has the advantage of constructing bridge to connect small human being and large buildings.

Ceramic's regional material characteristic is built from molecular level: the ingredient is from earth, and the production is followed by local traditional recipe of composition and techniques. Taking brick for example, the raw material of soil, sand and lime of the brick are different according to geological locations. Its manufacturing process including firing temperature and heat working is developed by the local professionals. Furthermore, the standard requirements of brick construction are not the same from place to place. These three aspects together affect the final products regarding size, colour and texture, and sometimes they are very much different from one place to another. This already become a common sense in building industry and a list of brick types named after origins provides clear evidence: Dutch – a hard light coloured brick originally from Netherlands (Figure 14); Cream City brick – a light yellow brick made in Milwaukee, Wisconsin (Figure 15); and Fareham red brick – a type of construction brick originated from Fareham, Hampshire…Because buildings and space are constructed at specific sites, the regionalism is one of the properties that architecture, as well as interior design were born with. Moreover, the regionalism of architecture has been the aspect to be addressed in academia and in industry more often than ever in recent years. Since both ceramic and architecture share the same regional character, it is clear to say that the use of ceramic in architecture is palpable and inevitable. Meanwhile, the sharing of the regional character suggests the design of ceramic furniture can be inspired from architecture.

Figure 14. Dutch Brick with carved-in year of construction: 1874.

Figure 15. Cream City Bricks.

Figure 16. House of Skara Brae.

Furniture in Architecture

The definition provided by professor Postell (2012) has indicated that furniture is never an object or product itself, its essence is to create space through size, location and orientation, and from this perspective, furniture can place itself within the discipline of architecture and interior design.

Looking into human history, nomadic societies existed earlier than the settled ones, which means that before houses, tents were the earliest "buildings" made by man. Since they had to travelled freely as weather and terrain permitted, their furnishings had to be portable and be light enough to carry along (Postell, 2012). Following these records, it's clear to say that furniture exists longer than architecture. In addition, they suggest that human arranged space with furniture far before they built houses. When human started to settle down at one location, then architecture was born. The pre-historical site of the stone house at Skara Brae (circa 3500-2600 BCE) (Figure 16) indicates that when our ancestors built houses, they built furniture at the same time and with the use of the same material and following the same method. This suggests that in the ancestors' mind, their purpose is not about building architecture and making furniture, instead, they were trying to create a living space which could accommodate various activities in the daily life including storing, seating and sleeping. From what mention before, it's clear to concludes that idea of interior design which is dividing space according to function was originated from building furniture with different purposes.

As a student in Aalto University, School of Arts, Design and Architecture,

Figure 17. Paimio chair in the Paimio Sanatorium.

Figure 18. Swan chair in the lobby of SAS royal hotel.

whose focus is furniture design, there's a history that I'm more familiar with: the furniture design was an independent MA study program at the beginning, then it joined by Spatial Design and together formed a new Spatial and Furniture Design. And after being a part of Product and Spatial Design (PSD) for a short period of time, it then left the Department of Design and join the Department of Architecture and is now under the roof of Interior Architecture. The changes of study program which is happening in one of the world's most important design schools gives away the trend of furniture design profession, and reveals its future in which it will form stronger and stronger alliance with architecture through time.

A list of world's most famous furniture design is another pile of evidence that demonstrates the profound relationship between furniture and architecture, but from a sensible perspective. The famous Paimio chair designed by Alvar Aalto was designed for Paimio Sanatorium (Figure 17); Swan chair was originally designed for SAS royal hotel by Arne Jacobsen (Figure 18); and the Chair Barcelona by Mies van der Rohe is for the German Pavilion in Expo 1929 (Figure 19). Interestingly to notice, these architecture-project-born furniture design haven't been restrained within their original projects from more than 50 years ago, instead, they have appeared in countless interior designs all around the world till today.

Figure 19. Barcelona chairs inside of Ludwig Mies van der Rohe's Barcelona Pavilion.

"… Places have developed an identity, an atmosphere, and a meaning as result. As designers, we select and specify the components that are the context of the attributes developed and held through these varied interpretations and experiences." (Verghese & Smith, 2013) These half a century years old design were integrated perfectly with the interior space where they were born, while stood out on their own and established their attributes through time. After being interpreted by more and more people with the same "messages", they become representations of their own style. In my opinion, that is what make them the classic design which can leap out the birthplace, and be seen everywhere throughout so many years.

Architecture possesses the purpose of providing function and experience to the users, and it works like this: by awakening the past memories and stimulate future expectations, the architecture contextualizes the present setting to the users once they set foot into the space (Verghese & Smith, 2013). Those furniture designs with exceeded attributes are among the list of the architecture components which work holistically to provide the experience. Designers placing them in space to communicate their intention to the users shows that furniture and space are speaking the same emotional language and are appreciated by the people through the same channels: the appearance of shape, colour and material, and the tactile sense and user experience. These channels works together to impress the users the same way as the whole architecture space.

Figure 20. Stonehenge.

The Tale of Scale

Analysing professor Postell's (2012) writing about furniture, interesting things are found: "hosting body and behaviour, ...storing, displaying and dividing." That is from the function summary of furniture, and in my opinion, it fits in architecture as well. "Composing place, providing elements to satisfy need to work, rest and play." That is the description of furniture purpose, and I don't think it would be any different from architecture's. "A broad range of movable objects" are the first words of Postell's furniture definition, and I believe those are the only words which are not describing architecture anymore.

The Stonehenge in Wiltshire, England is a prehistoric monument. A ring of stones with the heights around 4 meters, and the widths around 2.1 meters stand on a vast plain ground with no trees or things nearby, they form a semi open, round space speaking out ritual and monumental atmosphere. (Young, Chadburn, & Bedu, 2008). Since I have never been at the Stonehenge, What I can tell from the photos from the internet, especially the ones that don't have people in them, is everything but ritual and monumental atmosphere (Figure 20). The missing of scale has caused the missing of information. However, it also amplify other aspects of info. The picture of the lonely standing Stonehenge inspires me to spot the similarity between the earliest architecture and the basic of furniture: one stone placing horizontally on top of two other vertically placed stones. Without any other things in the photo, at first glimpse, it is no other than a stone stool placing on the grass.

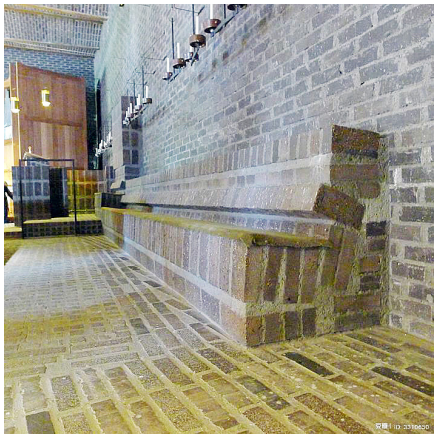


Figure 21. The pew at St. Peter's Church by Sigurd Lewerentz.

The word-to-word analyse of furniture definition, and the misunderstanding of Stonehenge photo might not be solid, academic testimonies to the statement that the only difference between architecture and furniture is scale. However, it's a direct, sensible awakening of considering it that way. Furniture is architecture in small scale, and they are the subjects to the same physical laws, they are built to fulfil the same need of function, space and emotion. With that in mind, using ceramic to build furniture seems intuitive.

Inspirations

Stone house at Skara Brae and St. Peter's by Sigurd Lewerentz visualize the integration between furniture and architecture: laying stones to build the walls and furniture, and laying bricks to build the church and church pew (Figure 21). The tangible relationship between furniture and architecture from those examples is built on that they share the same building system, and that inspires designing ceramic furniture in an architectural way. Brick is material, also a building system, what it presents to the viewers and users is not only the size, colour and texture that are the result of brick manufacturing, but also the idea and concept that lies behind the building and architect. So to say, a design of ceramic furniture inspired by brick system not only has the capability to present thesis' theoretical research to a certain level, but also it can demonstrate in real life that ceramic can be apart of the furniture world.

By establishing ceramic's importance in architecture design, and arguing

furniture is architecture, at least, part of it, this thesis has answered the research question “why to use ceramic in furniture.” Moreover, to communicate and translate the answer to the audience, a piece of furniture design is an essential part of the thesis. In order to present the thesis research and build up the connection between ceramic and furniture in real world, this furniture design needs to have impact to the space atmosphere, at the same time, to apply to brick building system. These two aspects has guided design to a more specific direction.

4. Design

This chapter documents the design and building process of a ceramic shelf prototype whose purpose is to demonstrate the connection between the material and product and answer the research question of why using ceramic in furniture. It contains the following sections: sketches of concepts, mockup, ceramic, metal & wood, assembly, photos of the final prototype and drawings & specifications.

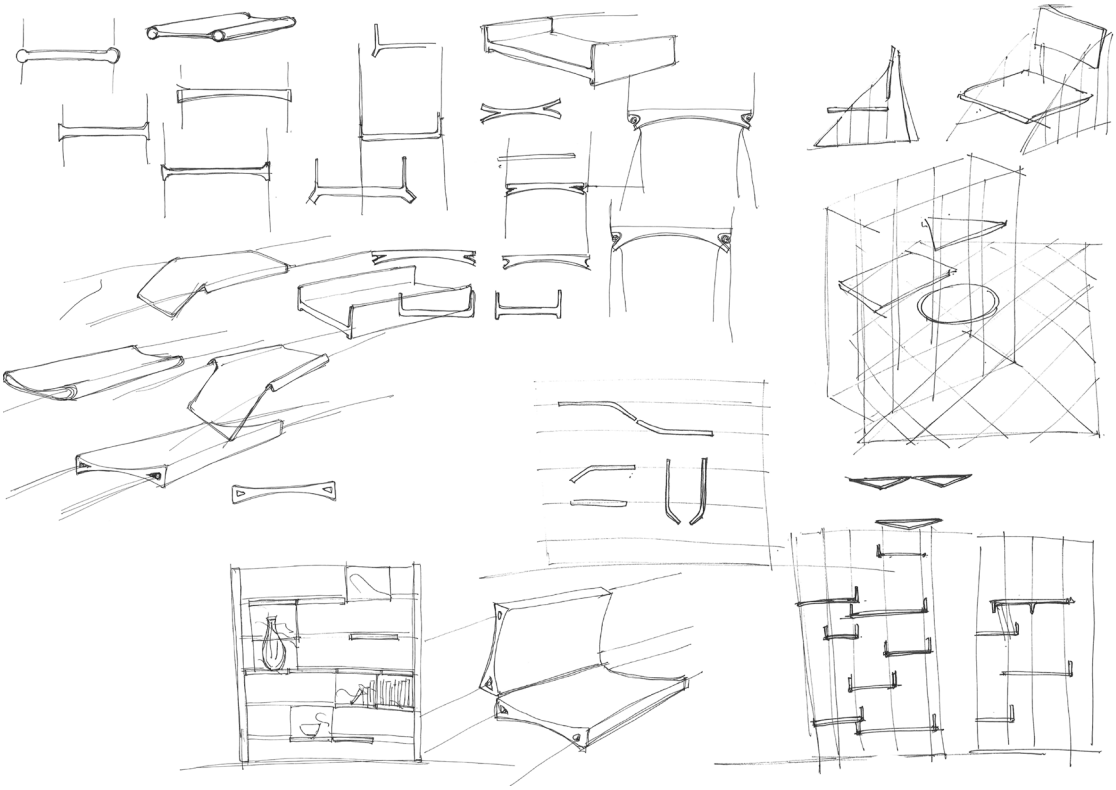


Figure 22. Concept I sketch collage.

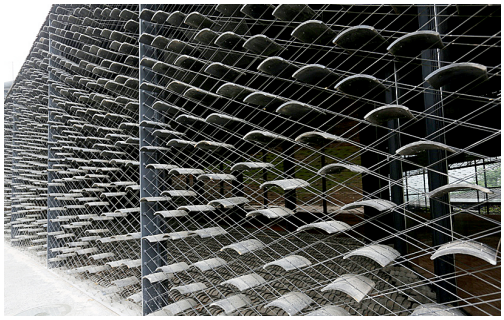


Figure 23. The façade of China Academy of Art's Folk Art Museum, Hangzhou.

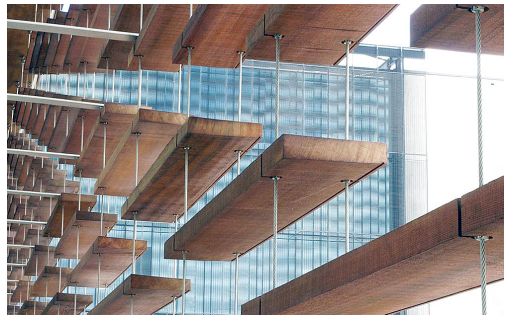


Figure 24. Facade Louver System – Smales Farm NZ.

Sketches of Concepts

Sketch is the translator between the theoretical research on paper and actual design in reality. The translation from research to design verifies in a certain range which is defined by the correctness of the information communicating to people. Comparing each translation is an easy way to determine and choose the one that carries the most compete and right information and can be understood by most people. So to say, the more sketches, the better, and the choosing and the sketch are equally important.

Keeping the inspiration summarized from previous chapter in mind, these following sketches are exploring the concept of design inspired by architecture.

Concept I (Figure 22)

Taking reference from the building façade (Figure 23 &24), this concept focuses on designing a structural modular system which can be applied to shelving and seats.

As one of the largest scale furniture in domestic environment, shelving has already become part of the interior component, which means that choosing to design a ceramic shelf has the potential of showcasing fully of the ceramic use in interior design. It also avoids material's weight issue in furniture design.

This idea focuses on visually minimizing the shelf structure using metal cable, and enhancing ceramic's function as surface to place objects, and as wall tile to display.

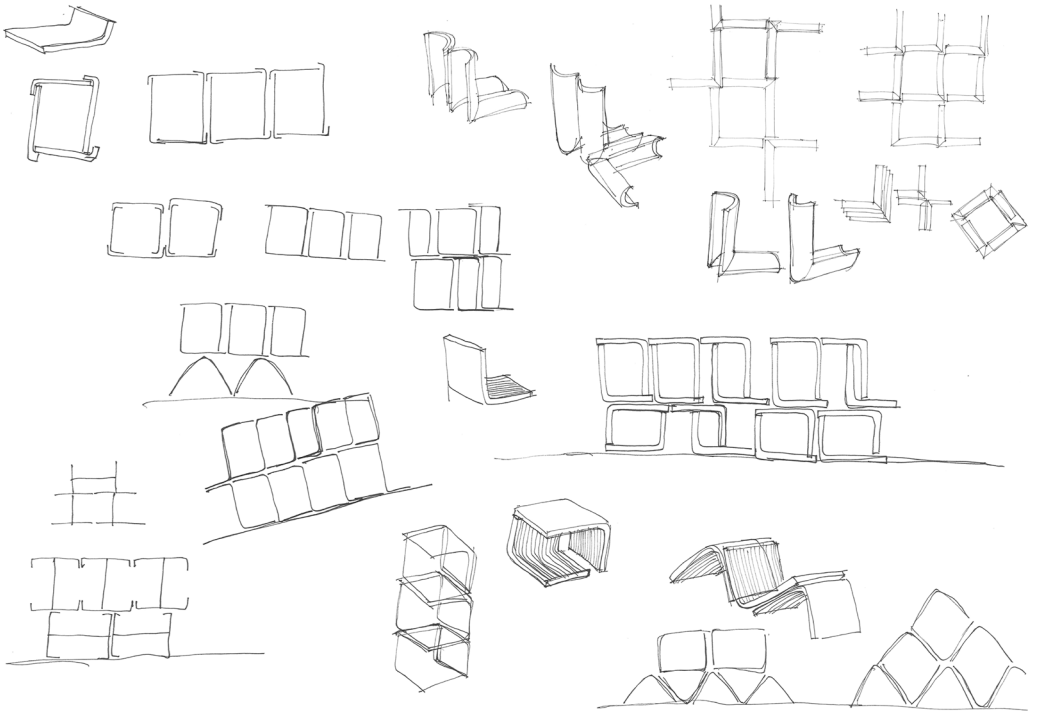


Figure 25. Concept II sketch collage.

Figure 26 & 27. The Façade and interior furniture of the Beehive project by Rosselli Architects.

Figure 28 & 29. The Façade and detail of Beijing Qianmen project by Kengo Kuma and Associates.

This sketch of design is too similar to certain façade which puts it a bit far into the architecture component category rather than furniture, so that it has been dropped.

Concept II (Figure 25)

Taking reference from the modular-system design in architecture (Figure 26-29), this concept aims at designing a ceramic unit that can be used to built up a proper functional furniture.

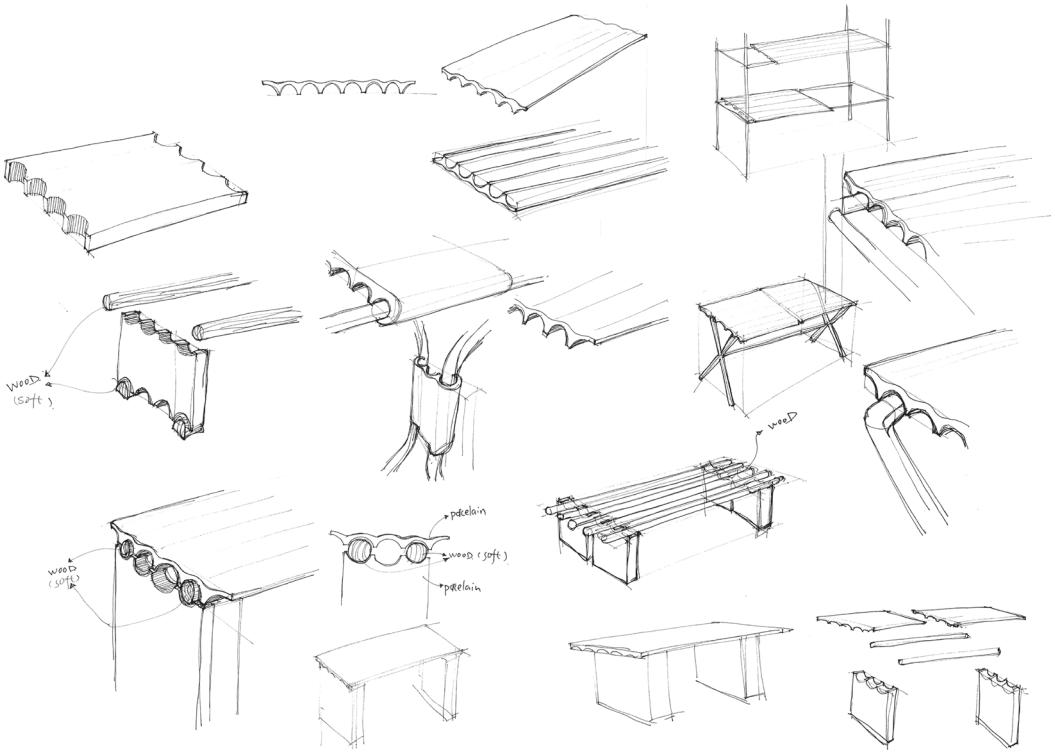


Figure 30. Concept III sketch collage.

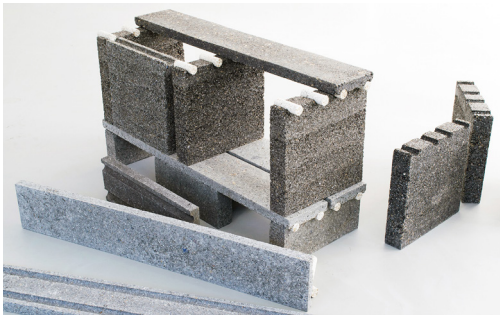


Figure 31. The recycling reject furniture project by Tim Teven.

Figure 32. The interior design of Aesop Park Slope by Frida Escobedo.

No matter is roof tile or brick, they exhibit strong intention and narrate clear story of the architect and designer. To present author's perspective, this concept is doing the perfect job.

The use of modular unit is the strength of this concept, but it does not provide a clear and doable solution to the practical aspect of using ceramic or any brittle material in reality. The brick system contains not only brick, the hard element, but also mortar, the flexible one, and this concept is dropped because it only focuses on the modular brick, and the intermediate mortar

is missing from the design.

Concept III (Figure 30)

This concept takes full advantage of the brick building system, it experiments various ways of combining different material together. In the case of the brick laying, the mortar is used to glue the brick together, it also functions as buffer to ease the slight change of shape and size among the individual brittle piece, so that they will not crack when in contact with each other. In the case of this design of ceramic furniture, ceramic is the "Brick", and wood has been chosen to be the "Mortar".

Inspired by the recycling furniture project by Tim Teven (Figure 31) and the interior design of Aescop shop in New York by Frida Escobedo (Figure 32), this concept discusses in detail the joinery of the hard and soft materials. Because it shows promising solution of using ceramic in furniture practically, and the combination of wood and ceramic is aesthetically appreciated, this design is chosen to develop further.

Concept IV (Figure 33)

This sketch starts with the modular units, at the same time, takes inspiration from the concept of affordance defined by James Gibson (1986, p. 127): "The affordance of the environment is that it offers the animal, what it provides or furnishes". Translating that into designing an object is to create an object with no specific function, and people use it according to its shape and spatial orientation (Figure 34 & 35).

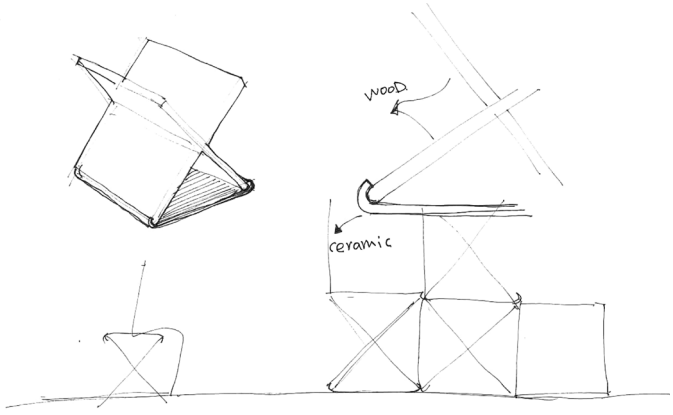


Figure 33. Concept IV sketch collage.

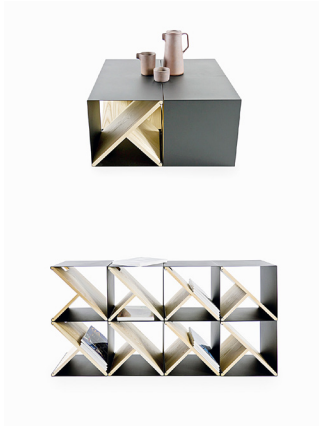


Figure 34 & 35. The steel stool by Noon studio.

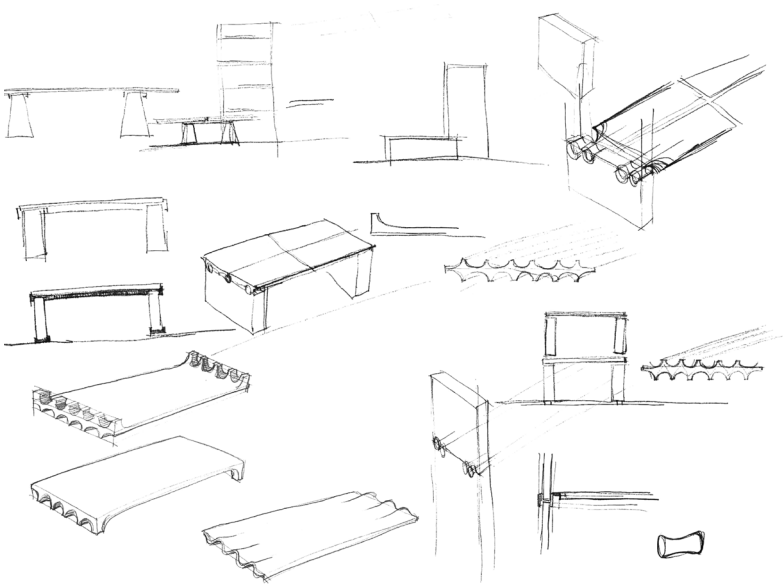


Figure 36. Concept III developing sketch collage.

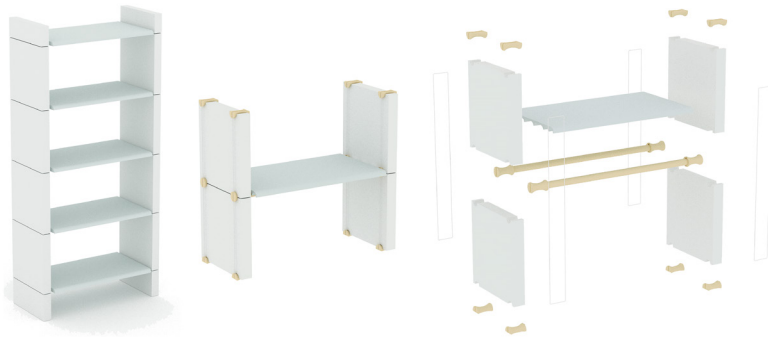


Figure 37. The computer modelling of the concept III shows the design detail.

This concept is more about modularity rather than material, which has caused the missing of utilizing ceramic's character in the design, and it is dropped.

Developing concept III (Figure 36)

After decided to choose *concept III*, more sketches regarding detail of the joinery and the shape of the furniture are produced to develop the concept further.

Computer Modelling (Figure 37)

Computer Modelling and rendering are used to have more accurate images of the shelf design regarding detail, scale and perspective.

Mockup

There are three mockup tests of the wall pieces in total, and the first mock-up is based on computer modelling, its existence is to test the validity of the concept in real world. It uses chipboard instead of ceramic to test the structure, since it is the faster way to see the concept works or not. The shape plays more important part here than material.

Due to author's lack of experience and structural knowledge, the mockup making didn't do its job to the fullest. Along with the three mockups listed below, the structure errors which had been overlooked during the process were also exhibited here as a lesson.

The shelf pieces do not play an important part in the overall structure, their shape which is mostly based on aesthetic appreciation is considered to be easy to adapt traditional ceramic making technique. It skips the mockup test and goes straight into the making process.

Mockup I (Figure 38)

This mockup uses clamps to press the chipboards to test the structural stability. The result is not so good as it shakes from side to side. It was initially diagnosed as lack of pressure to the chipboard, so the solution was to replace clamp with stronger pressing mechanism. Looking backwards, this was a warming sign from the beginning which the author did not pay attention to. There was no support from side to side to give stability to the whole structure, and it wasn't noticed and fixed until the material was replaced by ceramic and proper metal fixture was introduced.

Figure 38. Mockup I.

Figure 39. Mockup II.

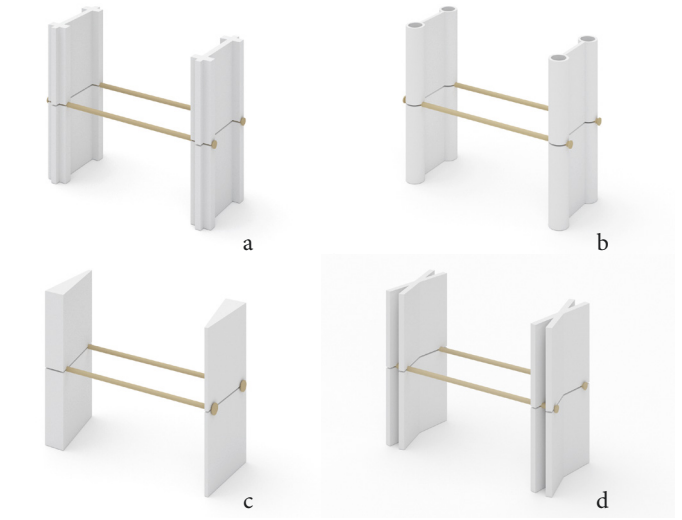


Figure 40. The abandoned designs of wall piece. (a~d)

Mockup II (Figure 39)

This mockup uses cable to generate force. Cable fasten is the firstly introduced in the process of developing *concept III*. The idea is to expose all the components in the design to the audience. Meanwhile, it creates an interesting detail of the material combination of wood, ceramic and metal.

The stability issue was pointed out once again: the design in *Computer Modelling* and *Mockup I* has limited contact area between the wall and wood beam. That limits the pressure and limits the support of the chipboard wall from both sides. At that time the finding of solution was focused on widening the chipboard wall and expanding the contact area. It

was thought that after widening, the pressure would be bigger and the two walls of the shelf would be much more stable as well. Turned out it worked. However, the shaking problem caused by no support from side to side was overlooked, and no design had been given to address that, again.

The idea of widening the wall gives birth to several design choices (Figure 40), and the final choice of design is based on technical and aesthetic consideration. Design b and d are abandoned because of the difficulties in ceramic casting and firing regarding the inner sharp angle and cylinder shape; design a and c are abandoned based on aesthetic consideration: the composition of the wall piece, wood beam and shelf piece in these designs are not highly appreciated by the author.

Mockup III (Figure 41)

The chipboard walls has changed to new design after the test of *mockup II*. The new design in structural test shows good result, no sign of supporting from side to side is needed. Nevertheless, looking backwards, this was the point that material started to play an important part in the text of structure integrity. Chipboards were light, so the test did not reveal obvious structural imperfection. However, after the chipboard walls were replaced by the ceramic walls, the weight of the walls increased significantly, and the shaking started to show.

Figure 41. Mockup III.

Ceramic

Ceramic making has started after *mockup III* shows positive result. In order to produce identical pieces, plaster-casting method is chosen, and it includes these procedures: model making, plaster mould making, casting, and firing.

In order to achieve the shape and measurement precision that is required by the joinery design of wood and ceramic, water jet cutting is introduced. Since the cutting will create sharp edges which are very brittle and hard to bond glaze, the surface treatment including sanding and glazing are applied to the ceramic pieces after the cutting.

There are two types of ceramic pieces in the design, the vertical placed ceramic wall and horizontal placed ceramic shelf. In the process of making, both of which employ similar steps. The shelves do not need the same level of precision as the walls, but in order to achieve similar design language, water jet cutting is used to utilize the length and width of the pieces. It also helps to create the straight and sharp edge style which is similar to the wall pieces.

Following the order of ceramic making, this section is composed with sections listed as following: *Model making; plaster mould making; slip mixing; slipcasting; high firing; cutting; glazing and firing*.

Model making

There are curvy surfaces in the model design of the ceramic pieces. Normally those can be made by CNC milling to achieve surface accuracy and continuity at the same time. The shape and size of the model affect the material choice, such as small details can only be made from hard material, and hard material has economical issue in large-scale model. Since the model is used to cast plaster mould, it is also important to be aware that the model should not absorb water, otherwise, it will expand and cause problems of extraction.

Affected by these factors, along with price and convenience, foam is chosen to make the wall model (Figure 42) and MDF is chosen to make the shelf model (Figure 43). Using foam for the wall model-making is because not only it can be easily shaped by CNC, but also it does not absorb water. Furthermore, it is cheap and light-weight. The softness of foam causes surface damage during the machine milling, however, since there is no small detail in the wall piece design, it can be easily fixed by post-milling procedures

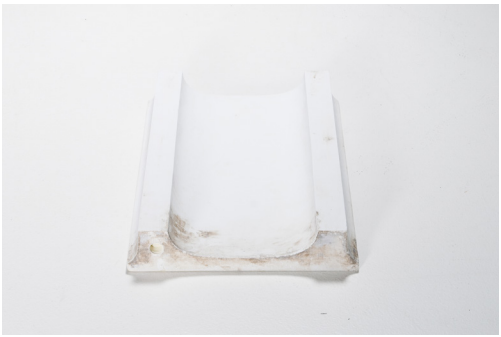


Figure 42. The model for wall casting.

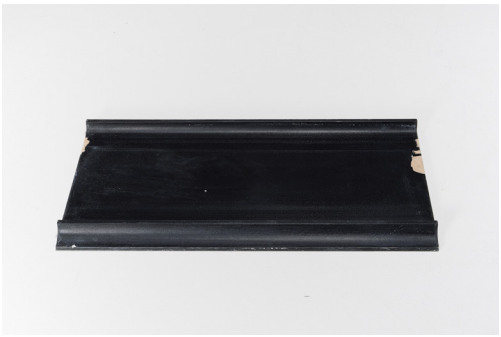


Figure 43. The model for shelf casting.

including painting and sanding. Choosing MDF to be the shelf model-making material is because it is a strong material to be shaped into small details (6mm). That is the priority consideration in the shelf piece model material-choosing process. As for MDF's drawback of absorbing moisture has been dealt with after-painting to seal the surface.

Model making is about material choosing. There is no perfect material in the world, so it is important to rank material's characters according to specific requirements, and then take post procedures to avoid and fix the less important issues.

Plaster mould making

The essential thing to be aware in *plaster mould making* is to make sure that the mould can be easily open and the cast piece can be easily extracted from the mould without any damage. In order to achieve that, both plaster moulds for casing the wall and shelf piece are divided into three parts (Figure 44-47).

Slip mixing

This ceramic shelf design is taken the advantage of ceramic's mechanical strength and surface texture rather than the craftsman property. The modular system as well as multiple-material design those have been adapted here indicate that keeping shape accuracy and consistency of the pieces are the most important aspect in the process. In order to achieve that and to prevent pieces from deforming during the firing, special slips are mixed to help to grow a thicker and firmer slip body during the casting. Two recipes have been used and tested in the process, the first one does not create a body strong enough, the second one has been a success and keeps using to cast both pieces (Figure 48 & 49).

Super Standard Porcelain	25%
Grolleg	20%
Nefeliinisyeniitti	20%
Aluminioksidi	35%
Water	38%
Dispex	0.2%

Figure 48. The first recipe of the slip.

Super Standard Porcelain	25%
Standard Porcelain	5%
Grolleg	10%
Nefeliinisyeniitti	20%
Aluminioksidi	25%
Molochite (0-0.075mm)	15%
Water	38%
Dispex	0.2%

Figure 49. The second and final recipe.

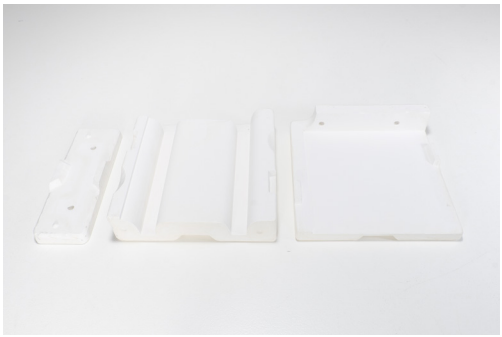


Figure 44 & 45. Plaster mould for casting the wall.

Figure 46 & 47. Plaster mould for casting the shelf.

Slipcasting

In the stage of *slipcasting*, the wall design generated from *Mockup III* has been reshaped. Initially the design of the wall piece was focusing on dealing with the structural issues, so that the protruding forms were introduced to the wall piece where it contacted with the wood. Then the wall was shaped into curvy outlines to adapt the casting method of ceramic. Nevertheless, one thing that had been overlooked was the inside structure of the wall which was affected heavily by slipcasting.

There are two reasons which make the hollow-wall-structure the better choice: first, it is lighter, and second, it creates a two-point-contact between the wall and wood beam. It can be more stable when in contact with the beam and more evenly transmits the force from the ceramic wall to the wood beam comparing to a solid-wall-structure. However, in the first attempt of casting the hollow structure, the result was not good. The protruding form had deformed and collapsed during the drying and hardening process after extracting from the mould. That was caused by the hollow middle part providing no support for the protruding forms (Figure 50).

Figure 50. Hollow middle part of the wall provides no support for the protruding form, so it bends badly after firing.

Figure 51. Reshaping the wall design, the middle part becomes slimmer.

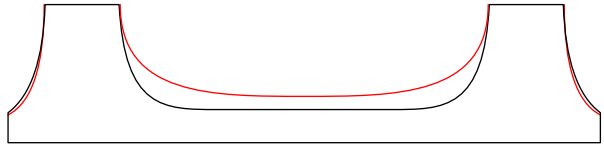


Figure 52. The outlines of the wall design, before reshaping and after. Red line represents before.

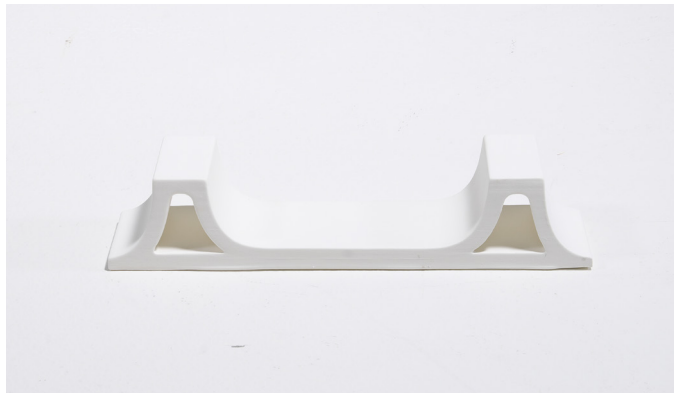


Figure 53. The section of the final wall design reveal its inside structure, the middle part is totally solid.

Two schemes have been suggested to deal with the issue. One is from material perspective: adjusting the casting slip recipe to grow a thick layer of the slip body so that the middle section of the wall will be sealed (Figure 49). The other one is from design perspective: reshaping the outline of the wall to make the middle part slimmer so that it can easily become solid (Figure 51 & 52). Both schemes have been adapted to make sure that the protruding form will not deform and the slip body of the ceramic wall will stay straight and unchanged after the casting and the firing (Figure 53).

Target Degree	Heating Speed	Soaking Time
250 °c	50 °c per hour	00:00
700 °c	100 °c per hour	00:00
1240 °c	full speed	00:30

Figure 54. The high-firing program.

Figure 55. A light-weight kiln shelf has been placed on the top of the wall piece during the high firing.

Since the shelf design is similar to ceramic sheet, it had been adapted to solid slipcasting method.

High Firing

Anything could happen in the kiln. All the things has been done in the previous stages are the attempt to prevent things from happening. There are measures to be taken during the firing as well, so that the wall pieces will not bend and deform, including slow firing program (Figure 54) and adding weight on the top of the wall pieces during the firing. In normal circumstance, that will be impossible since the slip body is not strong before the firing and will become softer during the firing. However, in this case, it is the perfect solution to keep the wall piece flat and straight. Because the unfired slip body has a rigid inner structure and is strong enough to withhold the weight (Figure 55).

Cutting

In order to have the same half-circle profile in which the wood beams are connected to the ceramic walls, all the wall pieces have been cut to the same outlines from both ends using the water jet cutting machine. At the same time, to avoid the slight shape inconsistency, which will be observable when the wall pieces are stacking along each other, the other two sides of the wall are also cut to straight edges to create unity (Figure 56).

The half-circle profile is located at the thickest part of the wall which is nearly 80 mm, and in order to keep a clean cut out surface, the machine has been adjusted to its full power as well as its slowest speed. At the same time, the machine is also adjusted to have the finest cut along the edges of the wall since these are the most visible part of the design.

After the first cutting test, the initial planed of the ceramic making process had been changed from slipcasting, glazing, high firing, and cutting to slipcasting, high firing, cutting, sanding, glazing and fir-

Figure 56. Both ends of the piece have been cut to the same half circle profile, and two sides of the piece have been cut straight.

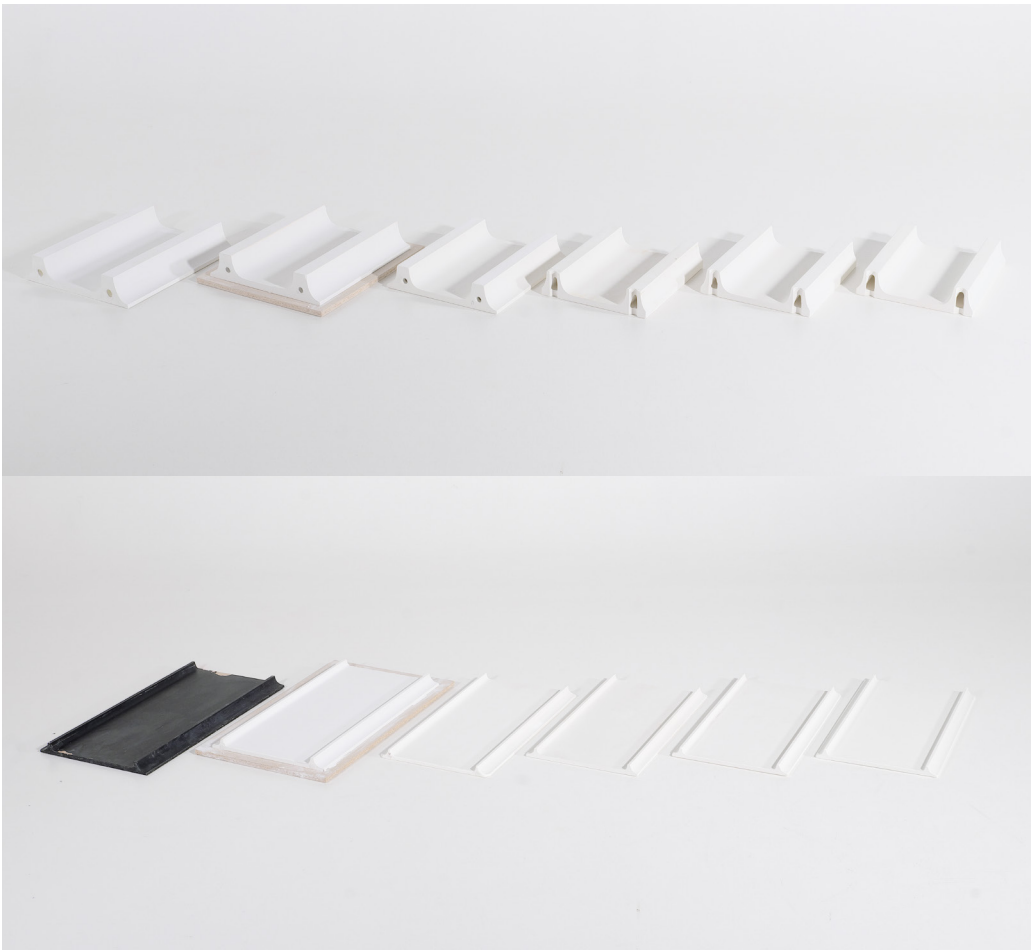


Figure 57 & 58. The six stages of the wall and the shelf pieces, from the model on the far left to final piece on far right.

ing (Figure 57 & 58). That is because firstly, the test cut piece turned out to be very dirty after the cutting. There was metal rust steam and sand steam all over the piece. If the *cutting* is placed at the last stage, there is no guarantee of a perfectly nice look of the final pieces. Secondly, in order to cover the cut out surface with glaze as well, which will make the pieces look nicer and finished, *glazing and firing* after *cutting* is the only option.

Glazing and Firing

As one of the strongest advantages of ceramic material, as well as the initially reason of introducing ceramic into the furniture design world, glazing gives ceramic objects uncountable choices of colour and surface textures. In this thesis, the author choose to focus on the basic colour white and test various surface textures (Figure 59 & 60).

The temperature of glaze firing is set to be lower than the previous *high firing* so that during the firing, the shape change can be reduced to minimum (Figure 61). The placing of wall pieces in the kiln has switched from horizontally in high fire to vertically in glaze fire, and the shelf pieces from one side to another, so that both the wall and shelf pieces can have as much surface as possible to apply glaze (Figure 62 & 63). Test pieces have been used to adjust the firing temperature and glaze formula in order to prevent the pieces from deforming and have properly melt glaze surface.

Before *glazing and firing*, the cut pieces have been through a sanding process during which the cutting edges are sanded to be smooth and round so that the glaze could be applied on to every corner of surfaces. The edge sanding leads to an unexpected shape modification course. The edges have been hand-crafted to a visible roundness using diamond sponge so that the pieces can return to a ceramic appearance to a certain degree after the cutting (Figure 64).

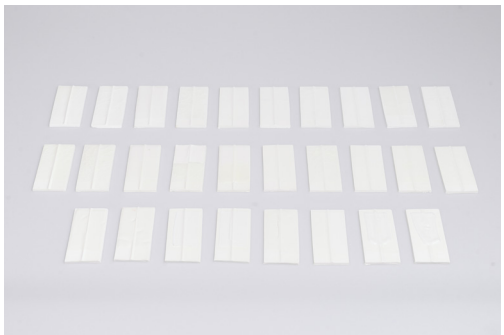


Figure 59. Primary glazing test pieces, dips to apply.

Figure 60. Final glazing test pieces, sprays to apply.

Ceramic is the material that needs be appreciated at close range. In turn, shelf is a type of furniture that needs be viewed from a distance. According to that, the design of ceramic shelf needs to have simple and elegant outline, at the same time, to provide rich details. In order to achieve that, the vast plain surfaces of the wall and the shelf pieces need to present a glaze finish that is both subtle and delicate. Matt white with small cracking texture underneath is the final choice. With this glaze covering the majority area of the body, the shelf looks like a combination of matt white blocks forming four stories of space with wood base and top when glimpsed at the first time. Then the ceramic comes to be recognized as the material of the white block after walking in and taking a closer look.

Metal & Wood

Mockup III uses cable fasten mechanism to provide structure stability. Later in the process, two issues had been pointed out regarding that mechanism: first was the lack of sophisticated visual presentation, and second was the lack of force it provided to maintain the structure integrity.

Metal rod with screws at both ends becomes the final choice of the fasten mechanism. It can be hidden inside the ceramic wall, and 5mm diameter

Target Degree	Heating Speed	Soaking Time
250 °c	50 °c per hour	00:00
700 °c	100 °c per hour	00:00
1200 °c	full speed	00:30

Figure 61. The glaze firing program.

Figure 64. The sanding of the edges gives the piece a visible roughness appearance.

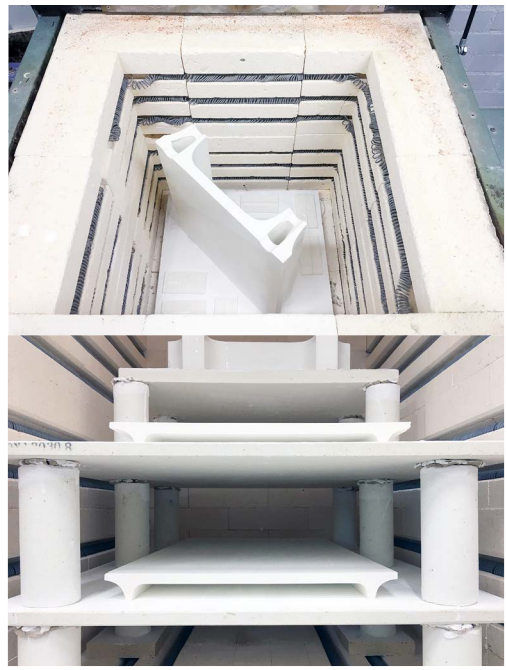


Figure 62 & 63. The vertically placed wall piece, and the upside-down placed shelf piece in the process of glaze firing.

rod can provide enough force to press the wall pieces and wood beams together to support the overall structure (Figure 65). *Mockup III* is focused on designing and testing the standard connection detail between the wall pieces, and it does not go deeply into the design of the ending wall pieces which contacts the ground and the sky. The early design of the ends was straight and simple, the shelf ended with ceramic wall pieces (Figure 66). Then the cable fasten system had been replaced, and the design of the ends had to change as well.

Instead of ceramic, wood have been introduced to be the end material for the following reasons: first, wood can work as cushion between the ceramic and other materials. Its flexibility and adaptive ability can protect the whole shelf from various using environments. Second, wood accommodate the metal rod fasten system well, its softness gently and evenly transmits the pressure generated by the rod to the ceramic wall pieces.

Choosing birch to make the wood part is because it was both strong and soft. During the mockup making and testing of the wood parts, pine was chosen to be the wood, and its strength issue had come up. In order to be the cushion between ceramic pieces, the wood also needs to be soft as well. After careful consideration and comparison, birch has been the choice to make the final prototype. It is strong enough to hold the weight of ceramic as well as the force of the metal rod fasten system, it is also soft enough to accept the half-circle shape of the ceramic without breaking it. Moreover, Birch possesses a colour and texture that is aesthetically matching with ceramic's glazing surface.

Figure 65. The change from metal cable to metal rod to fasten the shelf.

The first mockup test with ceramic pieces revealed that there was no structural support between the two walls, and the whole shelf shook badly from side to side. Because of that, the previous design of the ends had been dropped, instead of only from material perspective, structural issues had come to be the priority standard to check the mockup. Several end designs had been produced to test the strength, details and proportions (Figure 67).

Wood plays a much more important part in the overall design than I presume, its role has expanded from the "mortar" between the ceramic pieces, to the "safety cushion" of the environment, and structure of the shelf as well. It has the same material status as the ceramic in this design. In order to present that level of status into design, instead of following the design language of the ceramic pieces, wood has been given its own style to express the material character and corresponding techniques (Figure 68 & 69).

Assembly

The test of *assembly* was firstly done in half of the height. Then it is the full height. During the half-height test, the issue of unstable shaking revealed, and the solutions lie within the following options: strengthening the joinery of ceramic and wood; adding X-shape structure; and joining the wood end, both top and bottom. X-shape structure was not accepted in the first place because it destroyed the whole design. Since the current joinery of ceramic and wood was so simple and elegant, any change would break the simplicity and elegance, so that this option had been dropped as well. The idea of joining the wood ends will enlarge the visual impact on wood and

Figure 67. The mockups of the wood ends, from the design without beams on the far left to the final one on far right.

Figure 66. Early design of the wall ends were ceramic pieces.

Figure 68. Early design of the wood ends were the same shape as the ceramic pieces.

Figure 69. Early design of the wood ends were their own style.

Figure 76. Early design of the wood parts include a middle structure.

Figure 77. Full height test with the shelf piece on the top wood end.

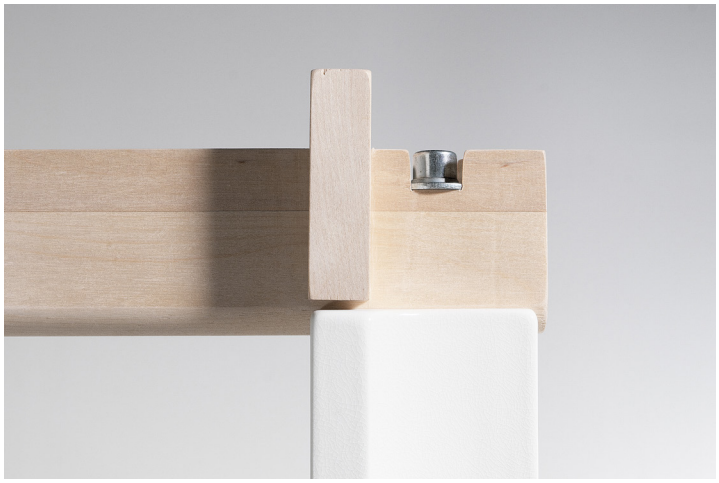
Figure 78. Full height test without the shelf piece on the top wood end.

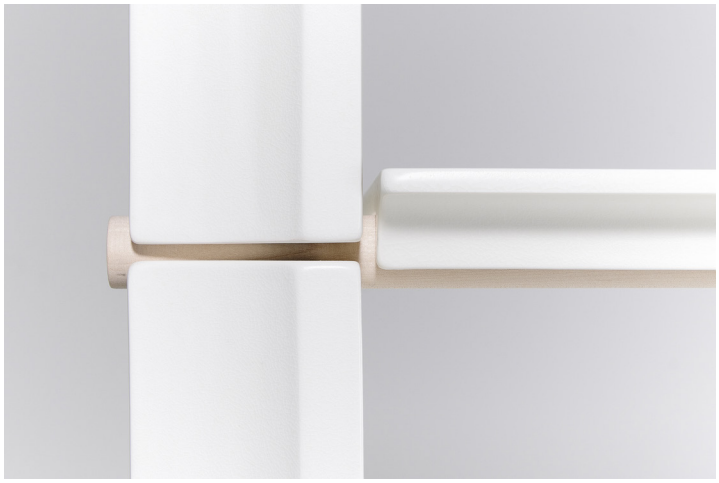
demolish the purity of the ceramic furniture to some extent, but it also provides the opportunity of designing a beautiful and useful detail, so it becomes the end solution (Figure 67). The final design of the wood ends is based on the invisible principle of wood manufacturing rather than the visible shape, otherwise it would be designed to follow the shape of ceramic walls. To create lightness in the ceramic furniture is another consideration affects the end result heavily (Figure 70-75).

The half-height test exposed the structure issue, and after that, the design had been focus on structure stability. As the result of that, in the early design a piece of wood structure has been added in the middle part of the shelf to strengthen the overall structure (Figure 76). Nevertheless, it turns out to be unnecessary after the full height test. Meanwhile, one more shelf piece on the top wood end also appeared in the old designs, and it was in the name of taking full advantage of the wood structure (Figure 68, 69, 76). The decision of taking it down is made after the full height test, in which the top shelf increases heaviness of the design (Figure77 & 78).

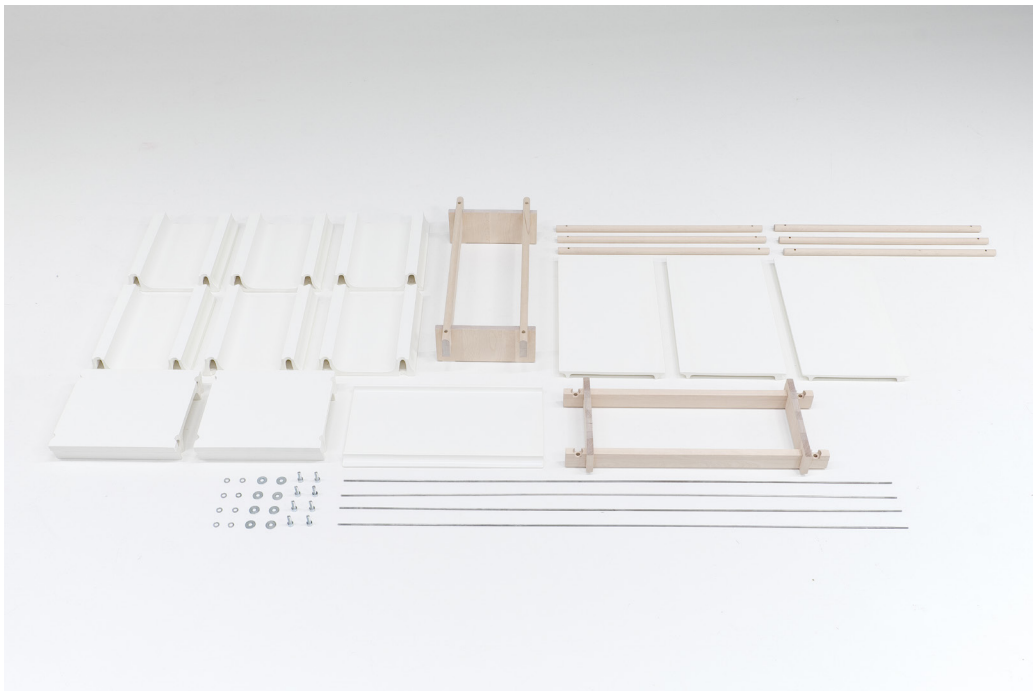
Figure 70-75. In the half height tests, strength of the structure and the proportion of the overall shelf are the dominant factors which guides the design transform from the earliest version a to the latest f.

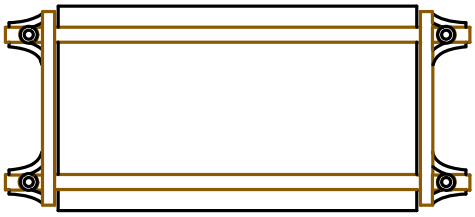
Photos of the Final Prototype





Drawings & Specifications





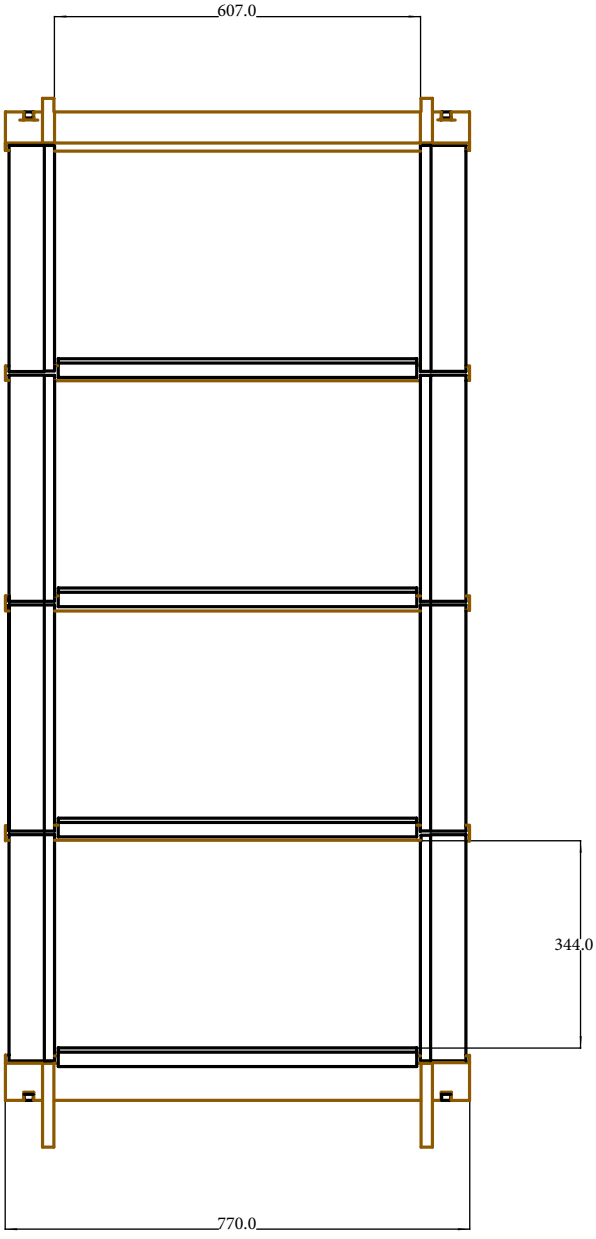
the Shelf

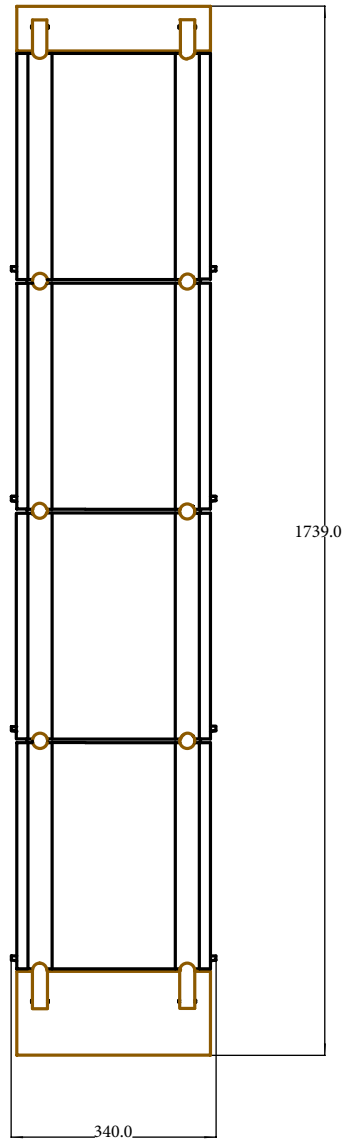
Dimension: 770mm X 340mm X 1739mm.

Weight: 94 kg.

Material: porcelain, birch, metal rod.

Amount: 1 piece.





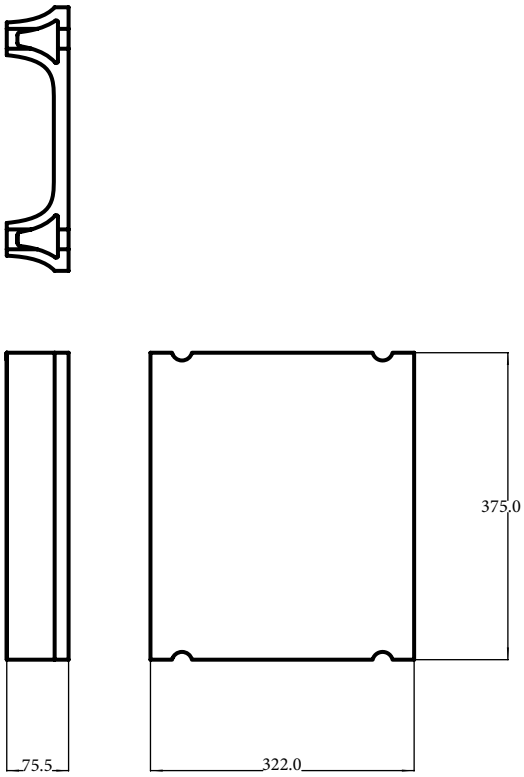
Wall Piece

Dimension:322mm X (74~77)mm X 375mm.

Weight: 6.8~8.2 kg.

Material: porcelain.

Amount: 8 pieces.



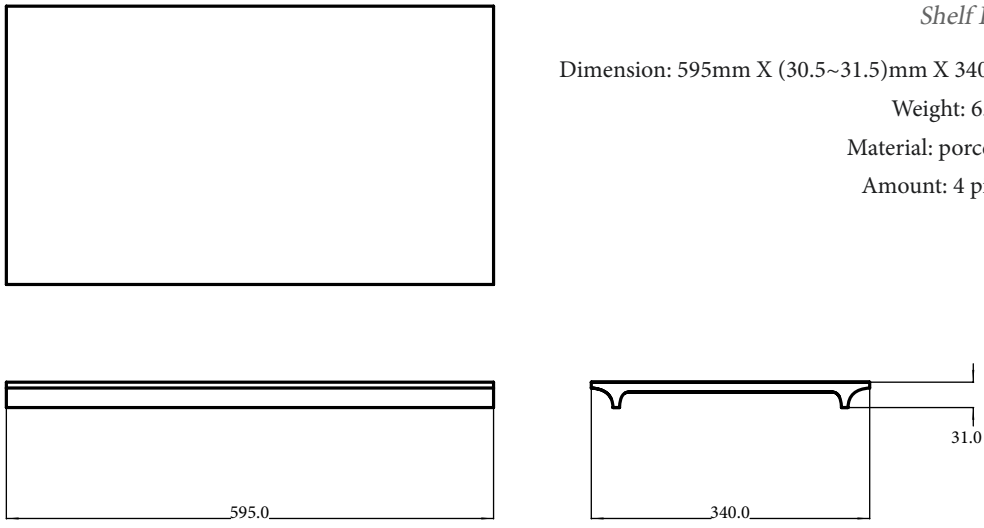
Shelf Piece

Dimension: 595mm X (30.5~31.5)mm X 340mm.

Weight: 6.3 kg.

Material: porcelain.

Amount: 4 pieces.



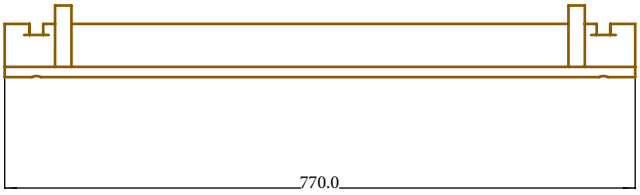
Top End

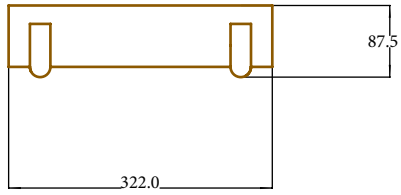
Dimension: 770mm X 322mm X 87.5mm.

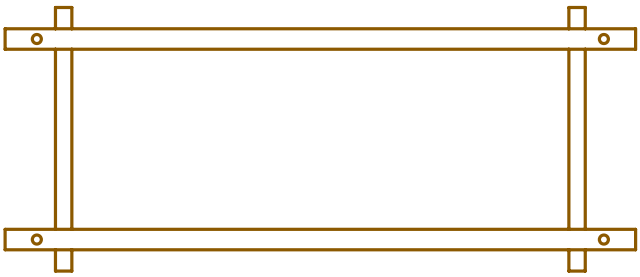
Weight: 2 kg.

Material: Birch.

Amount: 1 piece.







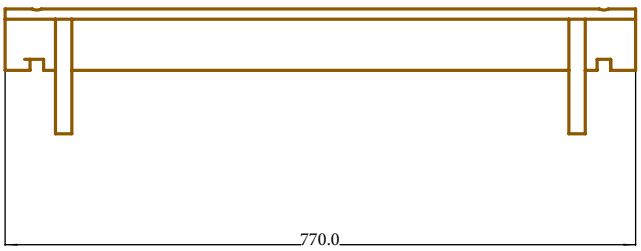
Bottom End

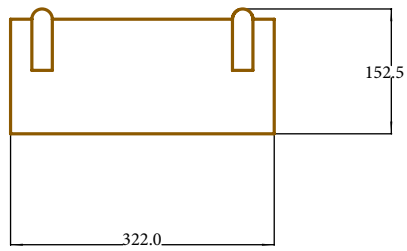
Dimension: 770mm X 322mm X 152.5mm.

Weight: 2.7kg.

Material: Birch.

Amount: 1 piece.





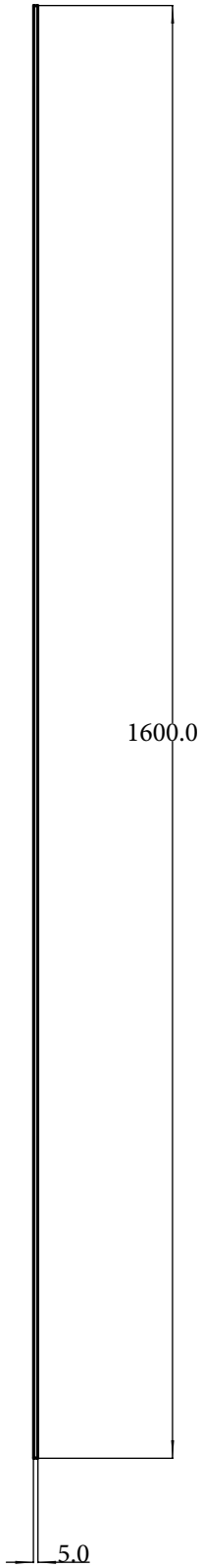
Rod

Dimension: 1600mm, Φ5mm.

Weight: 0.5 kg.

Material: Steel.

Amount: 4 pieces.



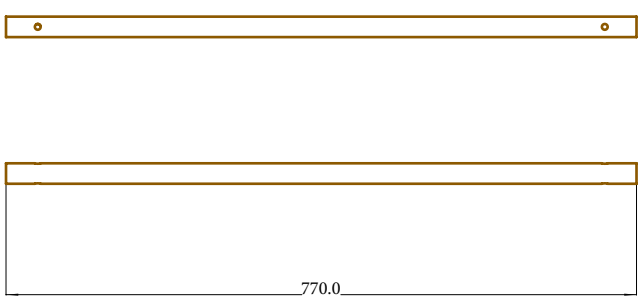
Beam

Dimension: 770mm, Φ25mm.

Weight: 0.2 kg.

Material: Birch.

Amount: 6 pieces.



5. Conclusion

This chapter aims to summarize the final design and assess the ceramic and furniture relationship built from it. In addition, this chapter discusses possible future implementation of the ceramic shelf. Lastly, this chapter presents the author's self-evaluation on the result as well as the personal journey.

Design Summary

Structurally speaking, the ceramic pieces in the design works vertically, they are stacked and pressed together, which is the best and most efficient way to use ceramic to bear force, examples also can be found in the applications of similar materials such as concrete and marble. In turn, the wood works horizontally in the design. It bears pull and push force to join two vertical ceramic walls together. This is the best and most efficient way to use it as well. Manufacturally speaking, the protruding parts of the ceramic wall pieces have been designed to be smooth and curvy, so that they can be taken out of the plaster mould easily. Meanwhile, the straight edges and flat surfaces of the wood parts suggest obviously that plainer and table saw are used to process the pieces. Taking full advantages of the material's strength and reflecting its manufacturing feature are the two guidelines which have been followed through the whole thesis process, because in my opinion, these guidelines are not only the great help of design, but also the definition of beauty.

The ceramic shelf design in this thesis has suppressed the hand-craft nature along with the uncontrollable property of the ceramic material. What it presents is not the ceramic objects most people are familiar with. Instead, is the pieces full of sharp angles, straight edges and unified shape. Ceramic, usually associated with craftsmanship and art, somehow fits perfectly to the rational world of furniture design, which means that its material versatility has been magnified. Furniture, in turn, has also absorbed ceramic perfectly in this design. What is showcased here is a shelf with creative material combination, sophisticated detail and surprising tactile feelings. This thesis has proved that introducing unusual material can bring the shelf from the background to the front stage. Shelf is rarely about itself but the space and environment divided and organized by it. In this thesis, the ceramic shelf design has utilized material and structure to become the centre of the attention. It testifies that shelf, as the most function-based furniture type, has the potential to be on its own even without putting anything on it. Extending this argument, the purpose of the furniture has been renewed and upgraded. So to say, both the material ceramic and the product furniture have found way to explore and expand their territory in design and are alive more than ever.

The connection between ceramic and furniture has been built through the transfer of property. Being a part of architecture, furniture can and shall use ceramic as one of its materials thanks to architecture's long and on-

going history of using ceramic to build, decorate and create space atmosphere. Even though this argument works in theory, and the final design of the ceramic shelf works in reality as well, there is still a gap between the theoretical explanation and the actual real-life design whose purpose is to demonstrate the theory. The critical point of translating and communicating the theoretical explanation to a wide audience through real-life design is the resemblance between architecture and furniture. Choosing shelving as the furniture typology to explore the use of ceramic is not only based on practical reasons such as avoiding ceramic's weight issue, but also based on its resemblance to architecture. As one of the dominant furnitures in the indoor environment, it is the closest furniture to architecture in scale as it can occupy the whole elevation of the space. However, because the final ceramic shelf design is only 750mm wide and 1740mm tall, it is too little to remind people of its connection to architecture and is too little to affect the space atmosphere. That means it has limited influence on people's thought of ceramic use in furniture design, which is where the gap lies between the theory and design. The limitation of time and energy that the author could provide on his own to design and build a shelf big enough to demonstrate a clear linkage between furniture and architecture had caused a fail to deliver a vivid example and presented the connection between ceramic and furniture on more sympathetic level. To resolve this issue, computer aid rendering was the only solution, it presents what it would like in a larger scale but with less direct impact (Figure 79).

Figure 79. A computer rendering shows ceramic shelf's large scale implementation.

Future Implementation

The advantage of most shelving design is their ability to expand and repeat, which was also the case with the shelf designed in this thesis. The most important aspect of the shelf design concept is the idea of using ceramic and wood at the same time. Based on that, this shelf with the use of modular ceramic pieces can be adjusted to various settings regarding size and scale, so that it can fit into different locations and space un-obstructively, which means that it can be brought to people's house according to the space and budget. Furthermore, the dimensions of the shelf design has been fine tuned to suit the standard filing system, so it can appear in public spaces such as offices as well, expanding the market and reaching more clients. More importantly and exclusively comparing to other shelving system, this one has the ability to easily accommodate and create space atmosphere according to the purpose and personal preference without compromising the utility. That is credited to the ability of ceramic to possess endless colour and texture options, as well as the unique way of construction so that the shelf can be detached and the ceramic pieces can be replaced easily.

Self-evaluation

The thesis objective stated in the previous background chapter specifies that a new "Ci Zuo Dun" should be created based on a new type of relationship between the material and product, so that it can be the representative of ceramic furniture on the map of today's design world. Even though it only represents the new relationship to some extent, as a properly functional furniture design, the ceramic shelf and its future implementation does introduce new features to shelving regarding unique tactical experience and space atmosphere. What the representative does is to testify the existence of ceramic furniture so that more and more design will be generated, and a land of its own will be established to provide originality to the design world. In my opinion, this objective has been achieved to a certain level. Its way of utilizing material has set up an modern ceramic furniture example, and I believe, it will give birth to many more brilliant designs to come.

Personally speaking, I am very happy and content, not only about the result, but also about the journey leading to it. I have learnt a lot, not only the way of thinking, but also the way of making. I begin to see more clearly the path I'm going and will go, the things that I like and will like, which is a path full of reason, logic, and of course, material.

Thank you, my MA thesis, for giving me experience, inspiration, and more importantly, giving me confidence.

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Figure 1. The ceramic table and stools in Sui Dynasty 595 AD. From "The discovery of the tomb of Zhangsheng, Anyang" by the Anyang Team of Archaeology Researh Institution, 1959, Archaeology, 10, p. 543

Figure 2. The ceramic Zuo Dun of colorful lotus with bolt decoration, Qing

dynasty (1725-1796 AD) . From "The ceramic Zuo Dun of colorful lotus with bolt decoration". Retrieved from https://www.dpm.org.cn/collection/ceramic/226746.html. Image courtesy of Palace Museum.

Figure 3. The black painted arhat bed with decorated ceramic landscape painting, early Qing dynasty (around 1700 AD). From "the black painted arhat bed with decorated ceramic landscape painting". Retrieved from https://www.dpm.org.cn/collection/gear/230908.html. Image courtesy of Palace Museum.

Figure 4. The rosewood Zuo Dun with four pillars, early Qing dynasty (16 Century AD). From Masterpieces from the Museum of Classical Chinese Furniture, Chinese Art Foundation, Chicago and San Francisco, (p. 13) by Yuan Quanyou, 1997, Tenth Union International Inc.

Figure 5. The rattan Zuo Dun in the painting of "Five Scholars from Tang Dynasty (618-907 AD)". From "Five Scholars from Tang Dynasty (618-907 AD)" by Liu Songnian, Song Dynasty (960-1279 AD). Retrieved from http://www.pwq4129.com/shufa/aritcle771.html

Figure 6. The rattan Zuo Dun and other ancient furnitures in the painting of "the Story Book of People", by Ying Chou, Ming Dynasty (1368-1644). Retrieved from https://digicol.dpm.org.cn/cultural/detail?id=773a2303a6194a1fa0940b2cf71b1de5. Image courtesy of The Palace Museum.

Figure 7. The obon coffee table by Simone Bonanni. From "Moooi official website", 2018. Retrieved from https://www.moooi.com/products/obon-tables. Image courtesy of Moooi.

Figure 8. The Keramos cabinets by Adriano Design and La Castellamonte. From "coprodotto homepage", by 2012. Retrieved from http://www.coprodotto.it/. Image courtesy of Coprodotto.

Figure 9. Upholstered Chair by Katharine Morling. From "Katharine Morling official website", 2014. Retrieved from https://www.katharinemorling.com/sculptures/dmlo3g8297cew4zstzczrdr01r2phv. Image courtesy of Katharine Morling.

Figure 10. Ceramic furniture by Lee Hun Chung. From "Lee Hun Chung official website". Retrieved from http://www.leehunchung.com/portfolio. Image courtesy of Lee Hun Chung.

Figure 11. Ceramic furniture by Lee Hun Chung. From "Lee Hun Chung official website". Retrieved from http://www.leehunchung.com/portfolio. Image courtesy of Lee Hun Chung.

Figure 13. Ceramic cones pressed into mud served as protective layer, Uruk, Samaria. From "Klink". Retrieved from http://cargocollective.com/klink/history-cone-mosaic-mesopotamia. Image courtesy of The Metropolitan Museum of Art.

Figure 14. Dutch Brick with carved-in year of construction: 1874. From "Rijksdienst voor het Cultureel Erfgoed", by Kris Roderburg, 2006. Retrieved from https://commons.wikimedia.org/wiki/File:Baksteen_met_ingekrast_bouwjaar-_1874,_zit_in_de_voorgevel_naast_het_risaliet_-_Zuidhorn_-_20388200_-_RCE.jpg

Figure 15. Cream City Bricks. From "Stone Creek Haven official website". Retrieved from https://stonecreekhavenllc.com/products/cream-city-bricks. Image courtesy of Stone Creek Haven.

Figure 16. House of Skara Brae. From "Historic Environment Scotland official website. Retrieved from https://www.historicenvironment.scot/visit-a-place/places/skara-brae/. Image courtesy of Historic Environment Scotland.

Figure 17. Paimio chair in the Paimio Sanatorium. From "Architect", by Gustaf Welin. Retrieved from https://www.architectmagazine.com/design/culture/the-enduring-legacy-of-paimio_o. Image courtesy of Alvar Aalto Museum.

Figure 18. Swan chair in the lobby of SAS royal hotel. From "Pamono". Retrieved from https://www.pamono.com/stories/up-in-the-air. Image courtesy of Radisson Blu Scandinavia Hotel.

Figure 19. Barcelona chairs inside of Ludwig Mies van der Rohe's Barcelona Pavilion. From "Knoll official website", 1929. Retrieved from https://www.knoll.com/knollnewsdetail/design-deconstructed-barcelona-chair. Image courtesy of The Architecture & Design Study Center, The Museum of Modern Art.

Figure 20. Stonehenge. From "Evan Evans". Retrieved from https://evanevanstours.com/blog/why-was-stonehenge-built/. Image courtesy of Evan

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Figure 21. The bench at St. Peter's Church by Sigurd Lewerentz. From "Douban", by Spring, 2014. Retrieved from https://www.douban.com/photos/photo/2200963788/.

Figure 23. The façade of China Academy of Art's Folk Art Museum, Hangzhou by Kengo Kuma and Associates. From "Kengo Kuma and Associates official website", 2015. Retrieved from https://kkaa.co.jp/works/architecture/china-academy-of-arts-folk-art-museum/, Image courtesy of Kengo Kuma and Associates.

Figure 24. Facade Louver System – Smales Farm NZ. From "Ronstan Tensile Architecture", 2008. Retrieved from https://www.ronstantensilearch.com/facade-louver-system-smales-farm-nz/, Image courtesy of Ronstan Tensile Architecture.

Figure 26 & 27. The Façade and interior furniture of the Beehive project by Rosselli Architects. From "Rosselli Architects official website", by Prue Ruscoe. Retrieved from https://luigirosselli.com/public-commercial/workspaces/beehive, Image courtesy of Rosselli Architects.

Figure 28 & 29. The Façade and detail of Beijing Qianmen project by Kengo Kuma and Associates. From "Kengo Kuma and Associates official website", Retrieved from https://kkaa.co.jp/works/architecture/beijing-qianmen/, Image courtesy of Kengo Kuma and Associates.

Figure 31. The recycling reject furniture project by Tim Teven. From "Dezeen online design magazine". Retrieved from https://www.dezeen.com/2018/12/29/tim-teven-recycling-reject-design/, Image courtesy of Tim Teven.

Figure 32. The interior design of Aesop Park Slope by Frida Escobedo. From "Frida Escobedo official webiste", 2019. Retrieved from https://fridaescobedo.com/project/aesop-park-slope/, Image courtesy of Frida Escobedo.

Figure 34 & 35. The steel stool by Noon studio. From "noon studio official website". Retrieved from https://noon-studio.com/portfolio/steel-stool/, Image courtesy of noon studio.

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By Jie Luo. Supervised by Ville Kokkonen, advised by Ville Kokkonen and Nathalie Lautenbancher.
Espoo, Finland. 2018.11~2019.10.